(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 August 2012 (30.08.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/115512 A1

(51) International Patent Classification:
F03D 1/02 (2006.01) *F03D 7/02* (2006.01)
F03D 3/02 (2006.01)

(21) International Application Number:
PCT/NL2012/050104

(22) International Filing Date:
22 February 2012 (22.02.2012)

(25) Filing Language: Dutch

(26) Publication Language: English

(30) Priority Data:
2006276 22 February 2011 (22.02.2011) NL

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: WIND TURBINE WITH TWO ROTORS

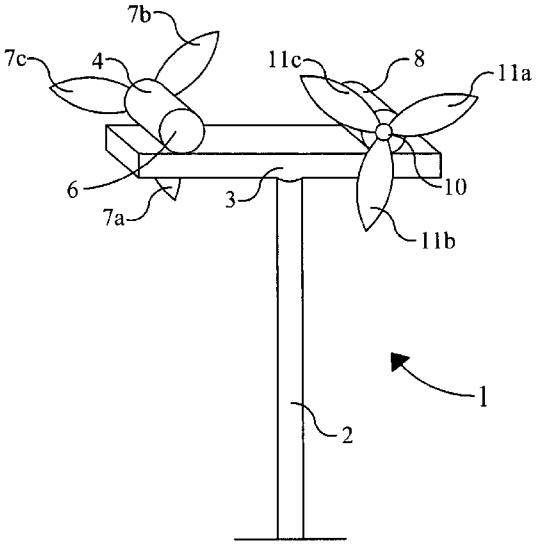


FIG. 1

(57) Abstract: The invention relates to a wind turbine, comprising a support construction, a first nacelle which is placed on the support construction and in which a first generator is placed, and a first wind turbine rotor adapted for approach flow in axial direction and having a substantially horizontally extending first shaft which is bearing-mounted in the first nacelle and coupled to the first generator, wherein at least a second wind turbine rotor with a second shaft is placed on the support construction. This measure provides the option of increasing the number of wind turbines at a single location, in particular on a single support construction, since the use of more than one wind turbine provides the option of converting more kinetic energy of the wind to kinetic energy of the wind turbine rotor, and thereby to electrical energy. The at least second wind turbine rotor is preferably adapted for axial approach flow and the second shaft extends substantially horizontally.

WO 2012/115512 A1

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Construction with multiple wind turbine

The present invention relates to constructions with wind turbines. The term wind turbine is used here to distinguish these wind turbines from classic windmills.

The invention relates more particularly to a wind turbine comprising a support construction, a first nacelle which is placed on the support construction and in which a first generator is placed, and a first wind turbine rotor adapted for approach flow in axial direction and having a substantially horizontally extending first shaft which is bearing-mounted in the first nacelle and coupled to the first generator.

Such wind turbines are generally known. They are adapted to generate electrical energy. For coupling of this electrical energy to the electricity grid converters are necessary which convert electrical energy generated with specific voltage and frequency by the generator to energy with the frequency and voltage of the electricity grid. This provides the option of optimizing the generator without having to take into account the frequency and voltage of the grid.

Particularly in densely populated countries the number of locations for wind turbines is limited; it is therefore important to use the available locations as well as possible, which means that as much electrical energy as possible must be generated at the available locations. The object of the present invention is to provide a wind turbine with which the greatest possible amount of electrical energy can be generated.

The object is achieved with a wind turbine of the above stated type wherein at least a second wind turbine rotor with a second shaft is placed on the support construction.

This measure provides the option of increasing the number of wind turbines at a single location, in particular on a single support construction, since the use of more than one wind turbine provides the option of converting more kinetic energy of the wind to kinetic energy of the wind turbine rotor, and thereby to electrical energy.

In accordance with the above, this embodiment also provides a method for placing a wind turbine, comprising the step of placing a support construction adapted to support

more than one wind turbine rotor and at least one generator with a power dimensioned for the at least one wind turbine rotor, and subsequently placing on the support construction the at least two wind turbine rotors and the generator to be driven by this wind turbine.

It is noted that the use of more than one wind turbine at a single location has limitations, for instance as a result of the fact that the kinetic energy of an amount of air passing the wind turbine decreases; some of this kinetic energy is transferred to the wind turbine so that only a part of the kinetic energy remains. Only a part of the kinetic energy of the air is therefore available for a second wind turbine placed immediately behind the first wind turbine, so that this second wind turbine can in general generate less energy. It is therefore generally more attractive to modify the design of the first wind turbine in order to increase the available power. This is in many cases not possible or worthwhile as a result of lack of space or other limitations. The advantages of the present invention are particularly manifest in such situations.

Because of their maintenance-free character, use is otherwise preferably made of brushless generators, such as synchronous or asynchronous generators, for generating electrical energy. For the turbine rotor use can be made of two-blade, three-blade or multi-blade rotors.

The placing of wind turbines involves a great deal of paperwork, particularly as a result of the permits required by legislation and other restrictions. In order to reduce this amount of paperwork it is sometimes attractive to provide a pre-existing wind turbine with an additional wind turbine rotor. Assuming that the existing wind turbine complies with all regulations, it is usually possible, without too many permits, to add a second turbine rotor, possibly with a second generator, to the support construction of the existing wind turbine.

A specific embodiment provides for this purpose a method for increasing the power of an existing wind turbine, comprising the step of arranging at least a second wind turbine rotor, and possibly a second generator, on the support construction of the existing wind turbine.

The power of an existing wind turbine can thus be increased, this of course within the above outlined limitations, without too many problems with regulations.

Although it is possible to couple the second wind turbine rotor to the already present first generator, because of the dimensioning of the generator it is recommended that a second generator is also placed, and that the second wind turbine is connected to the second generator.

According to a first embodiment, the at least second wind turbine rotor is adapted for axial approach flow and the second shaft extends substantially horizontally. A second or a subsequent wind turbine rotor is hereby added so that the overall power of the wind turbine increases. It is noted that in such cases the shafts of both turbine rotors will both extend parallel to each other and parallel to the wind direction.

The addition of a wind turbine rotor can take place through a placing such that the at least second shaft extends substantially parallel to the first shaft and that the projection of the first wind turbine rotor and the projection of the second wind turbine rotor at least partially overlap on a plane extending perpendicularly of the shaft. As a result of the fact that the projections of the two rotors overlap, only little extra space is required in this embodiment, while the power generated can nevertheless be increased.

It is noted that the size of the second rotor can be the same as that of the first rotor, although it is equally possible for the diameter of the first wind turbine rotor to be larger than that of the second wind turbine rotor. Other properties of the rotors, such as pitch of the rotor blades and the form of the rotor blades, can also differ or be the same.

It is also recommended that the second wind turbine rotor is adapted for direct approach flow. This reduces investment, simplifies assembly and has the smallest possible visual effect. This embodiment also provides a method wherein the second wind turbine rotor is adapted for direct approach flow and the second wind turbine is placed without air guide means.

A more specific embodiment provides the measure that the first shaft and the second shaft are coupled to the first generator. This measure requires a small investment

because use is made of a single generator. This single generator is preferably dimensioned to the power of both turbine rotors. When a second turbine rotor is arranged at a later time, this is less attractive in terms of investment because a new generator would then have to be installed. In order to avoid this, it is possible to suffice with the existing generator dimensioned to the power of the single, already placed wind turbine rotor. Because a wind turbine operates for the majority of the time at less than full power, sufficient power is then available in the generator. Optimum use is no longer possible only when the wind-force is so great that the sum of the power of both wind turbine rotors is greater than the power of the generator.

The latter embodiment can be further defined in that the first wind turbine rotor and the second wind turbine rotor are placed on the same shaft. This greatly simplifies the construction of the whole wind turbine, and in particular the bearing-mounting of the single shaft. A still further simplification results when the generator is also placed on the same shaft.

It is however also possible to provide the generator with a rotatable stator. This stator then in fact forms a second rotor. It is then attractive for the first shaft to be connected to the rotor of the first generator, for the second shaft to be connected to the stator of the first generator and for the turbine rotors to be adapted to drive the first shaft and the second shaft in opposite directions. Using a generator of determined dimensions double the power can hereby be generated than with a generator in which the stator does not rotate.

In a number of the embodiments elucidated here the generator or generators and the shaft or shafts are placed in the same nacelle. An alternative embodiment provides the measure that the second shaft is bearing-mounted in a second nacelle and that the second shaft is coupled to a second generator received in the second nacelle. There are therefore two or more nacelles here. This provides the option of placing the nacelles independently of each other so that there is no or hardly any overlap of the wind turbine rotors, and the one rotor does not deprive the other of wind.

According to another embodiment, the first and the second nacelle are connected to the support construction for independent rotation about a substantially vertical axis. This

measure provides the possibility of independently determining the angle at which the central axis of the nacelles extends. The direction of the central axis of the nacelles is determined in the first instance by the wind direction, since most benefit is gained from the wind energy when the central axis of the nacelle extends parallel to the wind direction. Since the wind direction will differ little at the relatively short distance at which the nacelles are situated, the direction of the central axes of the nacelles will in practice not differ much either.

In many cases the support construction is formed by a substantially vertically extending tower. For the purpose of arranging a subsequent nacelle having placed therein a generator with associated shaft and turbine rotor, it is attractive for the first nacelle to be connected to the top of the tower and for the second nacelle to be connected to the tower between the top and the foot of the tower.

The nacelle placed at the top of a tower is usually arranged for rotation about a vertical axis in order to be able to follow the wind direction. In order to allow the second nacelle to also follow the wind direction, it is important that the second nacelle is also rotatable about a vertical axis. This measure can be implemented structurally in simple manner when a first ring encircling the tower is connected to the tower, the second nacelle rests rotatably on the first ring, a second ring encircling the tower is connected to the tower and a yoke connected at a distance from the tower to the nacelle rests on the second ring. The tower need not after all be modified for this purpose, which could affect the strength of the tower and would also entail extra work operations.

Although wind generally moves in horizontal direction along the earth, there are situations in which the wind direction has a component in vertical direction, for instance at the coast. In order to also be able to make optimum use of the wind in such situations, it is attractive for at least one of the nacelles to be tiltable about a horizontal shaft extending substantially transversely of the rotation axis. This construction provides the option of allowing the shaft of the nacelle to extend parallel to the wind direction.

During rotation of a nacelle about a vertical axis the potential energy of the nacelle will not change; apart from friction losses, it therefore requires no force to rotate the nacelle about its vertical axis. Driving can therefore take place by a wind vane or a part

functioning as wind vane. Active driving of the rotation movement is otherwise by no means precluded. During rotation of the nacelle about a horizontal axis the potential energy thereof will however generally change unless the rotation axis passes through the centre of gravity of the nacelle, including generator, shaft and rotor. In the majority of cases a driving is therefore necessary for the rotation. A further embodiment provides for this purpose the measure that the tiltable nacelle is placed on a sub-frame, that the sub-frame is connected by a shaft to the support construction and that a controllable linear drive element is placed between the sub-frame and the support construction at a distance from the shaft. The linear drive element can for instance be formed by a hydraulic or pneumatic cylinder or by a preferably electrically driven screw spindle or combination of a gear rack with a gear wheel.

A downward extending pin is preferably arranged on the sub-frame and the pin can be coupled to a carrier which normally extends substantially horizontally and is connected to the support construction. This greatly simplifies assembly since only the carrier, which is usually not too heavy, need first be connected to the support construction, this connection usually requiring welding work and such time-consuming activities, and the subsequent placing of the nacelle, optionally placed on a sub-frame, can take place quickly. This measure therefore also provides a method wherein the nacelle with the second generator is connected to the support construction by initially connecting a substantially horizontal carrier to the support construction and subsequently placing thereon the nacelle with the second generator.

This embodiment moreover provides the option of the pin and the carrier being formed by a coupling usual in a combination of tractor and trailer and having a disc and a kingpin. These are after all components which are easily obtainable commercially and therefore inexpensive.

The above elucidated embodiments refer in each case to turbine rotors with axial approach flow, this designating that the wind direction extends parallel to the direction of the rotation axis and that the main plane of the rotor extends perpendicularly of the axis. This is the case for the majority of currently applied wind turbines. There are however also wind turbines wherein the approach flow direction extends radially of the rotation axis of the turbine rotor. An example of such a rotor is the so-called Darrieus

rotor. It is however also possible to apply turbine rotors of this type wherein the blades are arranged according to a cylinder. According to a preferred embodiment the at least second wind turbine rotor is adapted for radial approach flow and the second shaft extends substantially vertically.

A structurally attractive embodiment is obtained when the second wind turbine rotor is placed under the first wind turbine rotor. This does after all prevent the rotors 'taking the wind out of each other's sails', while the second cylindrical rotor forms a more closed whole and so entails fewer problems in terms of safety; after all, such a rotor has no protruding blades.

Wind is a phenomenon highly susceptible to variation. When generating electrical energy it is desirable that the momentarily generated power is as constant as possible in order to prevent overload of the components of the wind turbine. In order to avoid variations in the power by making the rotation speed of the generator as constant as possible, it is known to apply a flywheel on the shaft. In order to be effective such a flywheel has a large mass, and this results in structural problems. In order to obviate these problems, a further preferred embodiment of the invention proposes that at least one of the generators is provided with an inner stator and an outer rotor. The outer rotor is the rotating part, whereby the mass inertia or the flywheel effect is enhanced without arranging additional mass.

The rotation speed of turbine rotors of wind turbines is relatively low. This is particularly the case for turbine rotors with a blade length of several tens of metres. Electrical generators become smaller and cheaper - while having the same power - at higher rotation speeds. As a result gearboxes are often applied for the purpose of increasing the rotation speed of the turbine rotor so that the generator can be given smaller dimensions. Gearboxes, even when they have a planetary configuration, are susceptible to wear, require much maintenance and are susceptible to overload. In order to avoid these drawbacks another embodiment proposes that at least one of the wind turbine rotors is coupled directly to the rotor of the associated generator. The gearbox is hereby dispensed with, although the generator - with a constant power - must be given larger dimensions. This drawback is tolerated because a substantially maintenance-free construction can hereby be obtained.

According to a final embodiment, the shaft of the first wind turbine rotor is coupled to at least two generators. At first sight this embodiment does not appear very attractive; it is after all cheaper, in the case where power is determined by the turbine rotor, to apply a single generator with a high power than two generators each having a low power. There are nevertheless situations in which it is attractive to apply two generators. These are situations in which the turbine rotor is modified in an existing wind turbine, for instance enlarged or provided with other blades, whereby the power of the turbine rotor is increased. In order to also enable conversion of this increased power to electrical energy at strong wind-force an additional generator can also be placed. This additional generator can be the same as or smaller or larger than the generator already present. This placing is particularly easy when the generator already present is provided with a continuous shaft, so that the added generator can be placed coaxially relative to the generator already present. It may however also be attractive to apply two generators in a wholly new wind turbine, for instance when it is anticipated that the wind-force will only reach high values for short periods of time. A first generator is then always in operation and the second generator only when the wind-force is so great that the power of the first generator is exceeded. Because this second generator then has only a short operating time, a cheaper generator with a lower efficiency can be used for this purpose. The second generator can also be used in situations where the first generator is out of operation, for instance for maintenance or repair purposes.

The present invention will be elucidated hereinbelow on the basis of the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a first embodiment of the invention;

Figure 2 is a schematic side view of a second embodiment of the invention;

Figure 3 is a schematic side view of a third embodiment of the invention;

Figure 4 is a schematic front view of a fourth embodiment of the invention;

Figure 5 is a schematic side view of a fifth embodiment of the invention;

Figure 6 is a schematic side view of a sixth embodiment of the invention;

Figure 7 is a schematic side view in partial cross-section of a seventh embodiment of the invention;

Figure 8 is a cross-sectional view of an eighth embodiment of the invention; and

Figure 9 is a cross-sectional view of a ninth embodiment of the invention.

Figure 1 shows a wind turbine designated as a whole with 1. Wind turbine 1 comprises a tower 2 which functions as support construction and which takes a substantially smooth, cylindrical, perhaps slightly conical form. It will be apparent that other types of tower can be applied instead, such as lattice towers. A girder 3 is placed on top of tower 2 for rotation about a vertical axis. Girder 3 is embodied as box girder but can also be embodied in other manner, for instance as lattice girder. A first nacelle designated as a whole with 4 is placed on the first end of girder 3. A first generator 5 is placed in the first nacelle 4 and a first rotor shaft 6 is bearing-mounted in first nacelle 4. A first turbine rotor 7 with rotor blades 7a, 7b and 7c is mounted on rotor shaft 6. A second nacelle designated as a whole with 8 is placed on the second end of girder 3. A second generator 9 is placed in the second nacelle 8 and a second rotor shaft 10 is bearing-mounted in second nacelle 8. A second turbine rotor 11 with rotor blades 11a, 11b and 11c is mounted on rotor shaft 10. In the shown embodiment girder 3 is placed symmetrically relative to tower 2, but rotor 11 is placed on the other side of the nacelle. This does after all result in the lowest mechanical load on this girder 3 and on tower 2. An asymmetrical placing which is necessary as a result of lack of space or which is useful is not however precluded.

It will be apparent that the wind drives both turbine rotors 7, 11 in rotation, whereby rotor shafts 6, 10 are driven in rotation. These rotor shafts drive the generators 5, 9 placed in nacelles 4, 8, possibly via a transmission accommodated in nacelles 4, 8. These generators generate electrical energy which is supplied to the customer via a converter which is not shown in the drawing. The converter converts the voltage and frequency which are generated by the generators, and which both vary with the rotation speed, in order to adjust these values to those of the customer, for instance the electricity grid. The converter can be placed in nacelles 4, 8, but can also be placed in the tower or elsewhere. This embodiment is particularly, though not exclusively, suitable for a later increase in the power of the wind turbine. Use is made here of a wind turbine comprising only a tower 2 and, placed directly thereon, a nacelle 4 with generator 5, shaft 6 and rotor 7. In order to increase the power generated by this wind turbine the nacelle 4 and the parts 5, 6 and 7 mounted thereon and therein are removed, after which the girder 3 is placed, as is a bearing allowing a rotation about a vertical axis. The nacelle 4 and a new nacelle 8 are then placed, together with the parts 5, 6, 7, 9,

10 and 11 mounted thereon and therein, after which the configuration shown in figure 1 is obtained.

It is noted that in this embodiment the two rotors do not overlap each other, so that they have no or little influence on each other and there are no or few associated losses. The shafts also extend parallel, which results in an optimal position relative to the wind direction. The rotors also lie, though not necessarily, at the same distance from girder 3.

Figure 2 shows a wind turbine designated as a whole with 21. This wind turbine comprises a tower 22 on which a support construction 23 is placed. This support construction 23 is connected to tower 22 for rotation as a whole about a vertical axis. Placed in this support construction 23 is a first nacelle 24 in which is placed a generator 25 not shown in the drawing. Also mounted in nacelle 24 is a shaft 26, on the end of which is placed a rotor 27. Placed above the first nacelle 24 in support construction 23 is a second nacelle 28 in which a generator 29, not shown in the drawing, is once again accommodated, while a shaft 30 is bearing-mounted in nacelle 28. Shaft 30 protrudes here from nacelle 28 on the opposite side. A rotor 31 is placed on the end of the shaft. The rotors are thus situated on either side of tower 22. It will be apparent that the respective shafts 26, 30 are coupled to generators 25, 29.

This figure shows that the two nacelles 24, 28 are placed one above the other. This saves a girder 3 as present in figure 1, but entails the drawback that the two rotors 27, 31 lie one behind the other. In other words, the projections of the circles described by rotors 27, 31 largely coincide. Shafts 26, 30 of the two rotors 27, 31 will be turned during operation as parallel as possible to the wind direction in order to gain optimum benefit from the wind. The rotor lying upwind will here be able to extract energy optimally from the wind, but the following rotor will only be able to do so partially because a part of the kinetic energy of the wind has already been absorbed by the rotor lying upwind. The lower kinetic energy is reflected in a lower wind speed. It is also necessary to take into account the wake and the reduction in the wind speed which is caused thereby and which is caused by tower 22 because the second rotor lies downwind of the tower.

In this embodiment rotors 27, 31 have the same diameter and they also have the same blade shape and pitch. It is possible to envisage better results possibly being obtained by a mutually differing diameter, pitch or blade shape. The rotor lying downwind will have to be dimensioned here for a lower wind speed than the rotor lying upwind. It may be attractive in this respect to modify the generator 25, 29 connected to the associated rotor 27, 31 to this difference in terms of power or optimal rotation speed. It is otherwise possible to make allowance for another rotation speed by applying a transmission of different ratio between the shaft and the generator.

Figure 3 shows an embodiment largely similar to the embodiment shown in figure 2. The same reference numerals are used in this figure for corresponding parts. This wind turbine 21 comprises a tower 22 on which is placed a support construction 33 which is rotatable about a vertical axis and which differs from support construction 23 of the second embodiment. Two nacelles 24, 28 are placed on this support construction. In contrast to the second embodiment, nacelles 24, 28 are placed at the same height and mutually in line. This embodiment otherwise does not differ, or hardly so, from the second embodiment in respect of generators 25, 29, shafts 26, 30 or rotors 27, 31. There may also be differences in this embodiment between the rotors, generators or transmissions for the purpose of taking into account the upwind or downwind positions of the rotors. This embodiment is also suitable for the purpose of replacing a single wind turbine by a double wind turbine without too much intervention. While the energy output cannot hereby be doubled, it can however be greatly increased.

Figure 4 shows a wind turbine 41, wherein three turbine rotors are placed on a single carrier, two of these having a smaller diameter. The carrier takes the form of a tower 42 on which a nacelle 44 is placed by means of a rotatable support construction 43. This nacelle 44 is provided in the usual manner with a generator 45, a shaft 46 bearing-mounted therein and a rotor 47 mounted on the end of shaft 46. Up to this point such a wind turbine 41 corresponds to prior art wind turbines.

In order to increase the power generated by wind turbine 41 a second nacelle, not shown in the drawing, is placed on tower 42. This second nacelle has considerably smaller dimensions than nacelle 41. The second nacelle does not therefore extend into tower 42, but second nacelle 48 is mounted on a carrier 49 mounted rotatably on tower 42. A

generator is accommodated in the second nacelle and a shaft 50 (not shown) is bearing-mounted in the nacelle, while a turbine rotor 51 is mounted on the end of the shaft. The diameter of this turbine rotor 51 is considerably smaller than that of turbine rotor 47. The second turbine rotor can extract less power from the wind, so that the power of the generator placed in nacelle 49 is correspondingly smaller than that of generator 45 in nacelle 44 at the top of tower 42. It will be apparent that the second nacelle can be placed at a later time against the existing tower 42 so that the original wind turbine 41 can later be provided with an additional turbine rotor 51 and associated generator so that the power of wind turbine 41 as a whole can be increased. In the drawn embodiment the added rotors 51, 55 are placed on the rear side of tower 42 so that the blades of the rotors can overlap each other. The requirement for the situation where the rotors are all placed on the front side, that the circles described by rotors 47, 51 do not overlap, is hereby no longer applicable.

This figure also shows that an auxiliary tower 52 is placed on top of nacelle 44. Auxiliary tower 52 is preferably mounted here on the nacelle so that the auxiliary tower co-rotates with nacelle 44 and the wind direction. Placed at the top of the auxiliary tower is a third nacelle 53 which is provided with a generator, a shaft 54 bearing-mounted in nacelle 53 and a turbine rotor 55 mounted on shaft 54. This turbine rotor 55 is also smaller than turbine rotor 47, and the size thereof can correspond to that of the turbine rotor 51 mounted lower on the tower. The circles described by rotors 47, 55 do not overlap. The third nacelle 53 with the components 54, 55 mounted therein and thereon for generating electrical energy can also be placed at a later time on the existing wind turbine.

This embodiment thus provides two possibilities for increasing the power of an existing wind turbine. It is otherwise possible to add only one of the two turbine rotors. It is then recommended to add the upper rotor since the power thereof, at the same diameter, will be greater than that of the lower one because the wind speed high in the air is greater than that close to the ground. It is also possible - depending on the height of the tower - to mount more than one turbine rotor on the existing tower.

The wind turbine shown in figure 5 and designated as a whole with 61 comprises a tower 62 with a nacelle 64 arranged thereon by means of a rotatable bearing 63. This

nacelle 64 is also provided with a generator 65, a shaft 66 bearing-mounted therein and a turbine rotor 67 mounted on the end of the shaft. Up to this point this wind turbine 61 corresponds to a prior art wind turbine.

The wind turbine according to the invention is also provided with a first ring 70 arranged fixedly around tower 62. Resting on the first fixedly arranged ring 70 is a first rotatable ring 71, to which is attached a platform 72. Platform 72 is connected for rotation to rotatable ring 71. A second ring 73 is arranged fixedly under the first fixedly arranged ring 70. A second rotatable ring 74 rests on this second fixed ring 73. Platform 72 is provided with two support rods 75 extending obliquely downward from the end of platform 72 remote from tower 62 and connected to the second rotatable ring 74. A support construction connected rotatably to the tower is thus formed by these parts 70-75.

Placed on platform 72 is a second nacelle 74 which is provided in the usual manner with a generator 75, a shaft 76 bearing-mounted in the nacelle and a turbine rotor 77 mounted on the end of the shaft. A wind turbine is thus once again obtained which is provided with two wind turbine rotors. The generated power can hereby be greatly increased, also subject to the wind-force. As a result of the applied construction both turbine rotors are rotatable independently of each other about a vertical axis. Both turbines will in practice lie substantially at the same angle since the wind direction will hardly vary over the short distance between them. Because the turbine rotors partially overlap, the power generated by the rotor located further downwind will be smaller than that of the rotor located further upwind. As in the other embodiments, this construction is also suitable for later placing of the second turbine rotor with the associated components on an existing wind turbine.

The wind turbine shown in figure 6 and designated as a whole with 81 comprises a tower 82 on which a collar 83 is placed. This collar 83 is connected to tower 82 for rotation about a vertical axis. A frame 84 is connected fixedly to collar 83. A horizontally extending shaft 85 is placed at one end of frame 84 and a sub-frame 86 is connected to frame 84 for rotation about shaft 85. As a result of these measures the sub-frame 86 can tilt about shaft 85 and thereby take up an inclining position. For driving of the tilting movement use is made of a linear drive member 87 such as a hydraulically or

pneumatically driven cylinder or a linear electric motor. Arranged on sub-frame 86 is a nacelle 88 in which a shaft 89 is bearing-mounted.

Also arranged in nacelle 88 is an electrical generator 90 which is coupled to the shaft by a gear transmission. It is however also possible for shaft 89 to form the shaft of generator 90 and for the rotor of generator 90 to be placed on shaft 89. A turbine rotor 91, 92 is arranged on the two respective sides of shaft 89.

These measures provide a wind turbine wherein two turbine rotors are connected to the same generator. The generator will of course have to be dimensioned for the purpose of converting the power generated by two wind turbines. Such a combination can nevertheless result in savings, since generators for doubling a determined power are not twice as large as a generator for the determined power. The present configuration also makes an attractive construction possible wherein the rotor of the generator is driven by one of the turbine rotors 91 and the stator of the generator by the other turbine rotor 92. This does of course require a different construction for the stator because it must be rotatably mounted and must also be connected for rotation to turbine rotor 92. It is of course also important for this particular embodiment that the rotation of the rotor and stator is in opposite directions. A difference in speed between rotor and stator is hereby created in generator 90 which is double each of the individual speeds. Using a generator designed for a single turbine rotor, but without giving it a larger form, a power can thus be generated corresponding substantially to double the power. The stator must then of course be made rotatable, which entails a considerable modification of the construction. The measure of the two turbine rotors together driving a single generator can otherwise also be applied without the tilting as discussed below.

This embodiment also differs in that the whole assembly of sub-frame 87, nacelle 88, shaft 89, generator 90 and turbine rotors 91 and 92 is tiltable about a horizontal axis. The approach flow angle of the turbine rotors is hereby changed, so that it is possible to make allowance for a vertical component of the wind direction. It is noted that this measure can likewise be applied in single wind turbines according to the prior art and also in wind turbines according to the embodiments elucidated above in this document.

The exemplary embodiments described up to this point all have turbine rotors wherein the wind direction extends substantially parallel to the shaft of the rotor. This is the most common type of turbine rotor. Figure 7 however shows a seventh embodiment wherein, in addition to the 'normal' rotor, a rotor with radial approach flow is also placed. Such turbine rotors are per se known.

As in the foregoing embodiment, wind turbine 101 shown in figure 7 comprises a tower 102 on which is placed a nacelle 103 with a generator placed therein and a shaft 104 bearing-mounted in the nacelle. A turbine rotor 105 is mounted on the free end of shaft 104. The parts of wind turbine 101 described up to this point form part of the prior art.

Two bearings 106, 107 are mounted extending around tower 102. A cylinder 108 enclosing tower 102 is arranged on both bearings 106, 107. The rotor 109 of a generator is arranged on the inner side of this cylinder 108 and the stator 110 of the generator is placed on the outer side of the tower. Spokes 111 extend radially from the cylinder to a turbine rotor 112 of the type adapted for radial approach flow. Such turbine rotors have a substantially cylindrical structure. As a result of this construction the turbine rotor 112 can rotate around tower 102. Turbine rotor 112 is provided with vertically extending blades 113 which are formed such that a wind striking the turbine rotor 112 with a radial directional component exerts a torque on the turbine rotor and will cause the turbine rotor 112 to rotate.

For the purpose of converting the kinetic energy of the turbine rotor to electrical energy use is made of a generator 109, 110 arranged concentrically round tower 102. The structure of such a generator is such that the rotatable part, the rotor, is situated on the outer side while the stationary part, the stator, is situated on the inner side of the generator. This structure is unusual but is per se known. In a wind turbine of the present type an advantage of such a structure lies in the fact that the rotatable wind turbine encloses the generator, whereby it can easily be connected to the outer rotatable part of the generator. In applications with wind turbines having axial approach flow the advantage of generators with such structures can lie in the greater mass inertia of such a generator, whereby the effect of a flywheel is obtained.

The turbine rotor with a radial approach flow is better suited for placing at low position round a pre-existing tower of a wind turbine since there is hardly any danger of moving blades, as in the case of a turbine rotor with radial approach flow. The size of the turbine can be greatly varied, also subject to local conditions. It is however pointed out that there is generally less wind-force close to the ground.

The eighth embodiment of a wind turbine 121 shown in figure 8 comprises a tower 122, on the top of which a thrust bearing 123 is placed. Placed resting on thrust bearing 123 is a substantially cylindrical bush 124 which is closed on its upper side and open on its underside. Placed between the inner side of bush 124 and tower 122 is an annular bearing 125 which transfers the transverse forces on bush 124 to tower 122. Two horizontally extending beams 126 are attached parallel to each other to the upper surface of bush 123. For the purpose of supporting the beams 126 two arms 127a, 127b extend between the casing of bush 124, preferably at the position of annular bearing 125 and the ends of the beams 126. The configuration preferably takes a symmetrical form. Four generators 128a, 128b, 128c and 128d are placed coaxially on both beams 126. A shaft 129 extends through generators 128. A large turbine rotor 130a, 130b and a small turbine rotor 131a, 131b are each arranged at both ends of shaft 129. The blades of the large and the small turbine rotor 130, 131 are displaced relative to each other so that the blades are always distributed as uniformly as possible over the circumferential angle. This embodiment can also be provided with a tilting device for the purpose of tilting the shaft of the turbine rotors and generators, as already elucidated in figure 6. Use can also be made in this embodiment of pin and disc constructions as applied in tractors and trailers.

Finally, figure 9 shows an embodiment which differs only in a limited number of measures from the embodiment shown in figure 8. In the first instance the dual turbine rotors of figure 8 are replaced by single turbine rotors 130a and 130b which are both connected to the rotors of generators 128. Placed in the space between generators 128 is an electric motor 132 which can serve to start the rotation of turbine rotors 130.

The greatest differences between the embodiments of figures 8 and 9 lie in the mounting of generators 128 and the beams 126 connected thereto on the supporting construction. For mounting of this assembly forming the nacelle a downward extending

pin 133 is arranged on the underside of beams 126. Placed on the upper side of tower 122 as in the embodiment of figure 8 is a thrust bearing 123 having thereon a bush 124 and an annular bearing 125. In contrast to the embodiment of figure 8, a yoke 134 on which a disc 136 is placed for rotation about a horizontal shaft 135 is placed on bush 124. Arranged in disc 136 is an opening 137 in which the pin 133 can be secured. Use is preferably made for this purpose of a combination of disc 136 and pin 133 as known in the transport world for mutual connection of a tractor to a trailer. The pin is referred to here as a kingpin. Such a combination is provided with a locking pin 138 which is connected resiliently to disc 136 and which is urged inward by a spring in order to engage in a groove arranged in pin 133 and thereby lock the pin 133. This embodiment is also provided with arms 127 of a variable length. This variable length is necessary for the purpose of controlling the degree of tilting of the assembly of beams 126 and the generators 128 placed thereon. The length of the arms is made variable by placing a gear rack 139 which can be driven by means of a gear wheel driven by an electric motor. Thus tilting the generators 128 and the turbine rotors 131 mounted thereon makes it possible to adapt the axis of wind turbine rotors 130 to the wind direction when the wind direction is not parallel to the surface of the earth. It is noted here that such a construction need not necessarily be situated per se at the top of a tower; it is likewise possible to provide an existing tower with a spacer and to place the above described construction thereon.

The use of more than one, i.e. four, generators makes it possible to apply standard generators, thereby decreasing the cost price. In the drawn embodiment a space is left clear between the two central generators, this facilitating access to the nacelle, not shown in the drawing, in which the generators are situated. It is noted that the continuous shaft with which the turbine generators are coupled is not essential per se; it is likewise possible to have each of the turbine rotors drive two generators. In another bearing construction a part of the bearing can also be placed between the generators. Nor is it precluded that a part of the space is occupied by a smaller generator which can for instance be adapted to generate exciting current. In this embodiment it is important that the turbine rotors each take a multiple form and that the turbine rotors each drive more than a single generator.

Finally, it will be apparent that measures elucidated on the basis of the above embodiments can be combined with each other and that these embodiments cannot be deemed as being limitative for the scope of protection of the claims.

Claims

1. Wind turbine, comprising a support construction, a first nacelle which is placed on the support construction and in which a first generator is placed, and a first wind turbine rotor adapted for approach flow in axial direction and having a substantially horizontally extending first shaft which is bearing-mounted in the first nacelle and coupled to the first generator, **characterized in that** at least a second wind turbine rotor with a second shaft is placed on the support construction.

2. Wind turbine as claimed in claim 1, **characterized in that** the at least second wind turbine rotor is adapted for axial approach flow and that the second shaft extends substantially horizontally.

3. Wind turbine as claimed in claim 2, **characterized in that** the at least second shaft extends substantially parallel to the first shaft and that the projection of the first wind turbine rotor and the projection of the second wind turbine rotor at least partially overlap on a plane extending perpendicularly of the first and second shafts.

4. Wind turbine as claimed in any of the foregoing claims, **characterized in that** the diameter of the first wind turbine rotor is larger than that of the second wind turbine rotor.

5. Wind turbine as claimed in any of the foregoing claims, **characterized in that** the second wind turbine rotor is adapted for direct approach flow.

6. Wind turbine as claimed in claim 3, **characterized in that** the first shaft and the second shaft are coupled to the first generator.

7. Wind turbine as claimed in claim 6, **characterized in that** the first shaft and the second shaft coincide.

8. Wind turbine as claimed in claim 7, **characterized in that** the first shaft is connected to the rotor of the first generator, that the stator of the first generator takes a rotatable form, that the second shaft is connected to the stator of the first generator and

that the turbine rotors are adapted to drive the first shaft and the second shaft in opposite directions.

9. Wind turbine as claimed in claim 2, **characterized in that** the second shaft is bearing-mounted in a second nacelle and that the second shaft is coupled to a second generator received in the second nacelle.

10. Wind turbine as claimed in claim 9, **characterized in that** the first and the second nacelle are connected to the support construction for independent rotation about a substantially vertical axis.

11. Wind turbine as claimed in claim 10, **characterized in that** the support construction comprises a substantially vertically extending tower, that the first nacelle is connected to the top of the tower and that the second nacelle is connected to the tower between the top and the foot of the tower.

12. Wind turbine as claimed in claim 11, **characterized in that** a first ring encircling the tower is connected to the tower, that the second nacelle rests rotatably on the first ring, that a second ring encircling the tower is connected to the tower and that a yoke connected at a distance from the tower to the nacelle rests on the second ring.

13. Wind turbine as claimed in any of the foregoing claims, **characterized in that** at least one of the nacelles is tiltable about a horizontal shaft extending substantially transversely of the rotation axis.

14. Wind turbine as claimed in claim 13, **characterized in that** the tiltable nacelle is placed on a sub-frame, that the sub-frame is connected by a shaft to the support construction and that a controllable linear drive element is placed between the sub-frame and the support construction at a distance from the shaft.

15. Wind turbine as claimed in claim 14, **characterized in that** a downward extending pin is arranged on the sub-frame and that the pin can be coupled to a carrier which normally extends substantially horizontally and is connected to the support construction.

16. Wind turbine as claimed in claim 15, **characterized in that** the pin and the carrier are formed by a coupling usual in a combination of tractor and trailer and having a disc and a kingpin.

17. Wind turbine as claimed in claim 1, **characterized in that** the at least second wind turbine rotor is adapted for radial approach flow and that the second shaft extends substantially vertically.

18. Wind turbine as claimed in claim 17, **characterized in that** the second wind turbine rotor is placed under the first wind turbine rotor.

19. Wind turbine as claimed in any of the foregoing claims, **characterized in that** at least one of the generators is provided with an inner stator and an outer rotor.

20. Wind turbine as claimed in any of the foregoing claims, **characterized in that** at least one of the wind turbine rotors is coupled directly to the rotor of the associated generator.

21. Wind turbine as claimed in any of the foregoing claims, **characterized in that** the shaft of the first wind turbine rotor is coupled to at least two generators.

22. Method for placing a wind turbine, comprising the step of placing a support construction adapted to support more than one wind turbine rotor and at least one generator with a power dimensioned for the at least one wind turbine rotor, and subsequently placing on the support construction the at least two wind turbine rotors and the generator to be driven by this wind turbine.

23. Method for increasing the power of an existing wind turbine, comprising the step of arranging at least a second wind turbine rotor on the support construction of the existing wind turbine.

24. Method as claimed in claim 23, **characterized in that** a second generator is also placed, and that the second wind turbine is connected to the second generator.

25. Method as claimed in claim 23 or 24, **characterized in that** the second wind turbine rotor is adapted for direct approach flow and that the second wind turbine is placed without air guide means.

26. Method as claimed in claim 23, 24 or 25, **characterized in that** the nacelle with the second generator is connected to the support construction by initially connecting a substantially horizontal carrier to the support construction and subsequently placing thereon the nacelle with the second generator.

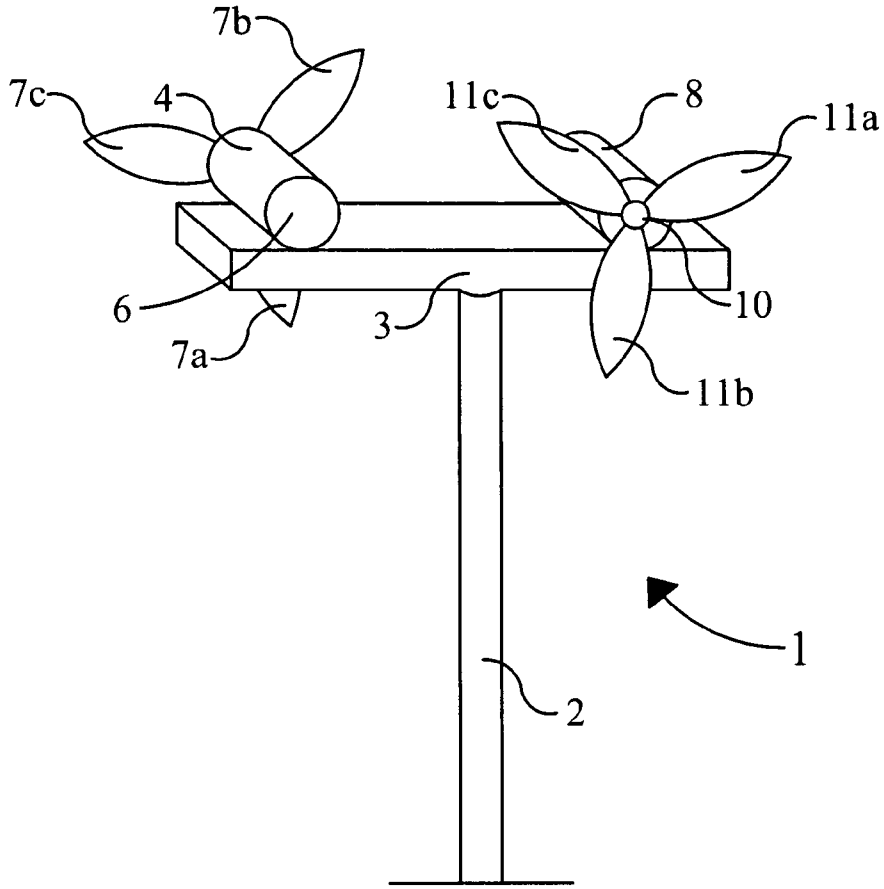


FIG. 1

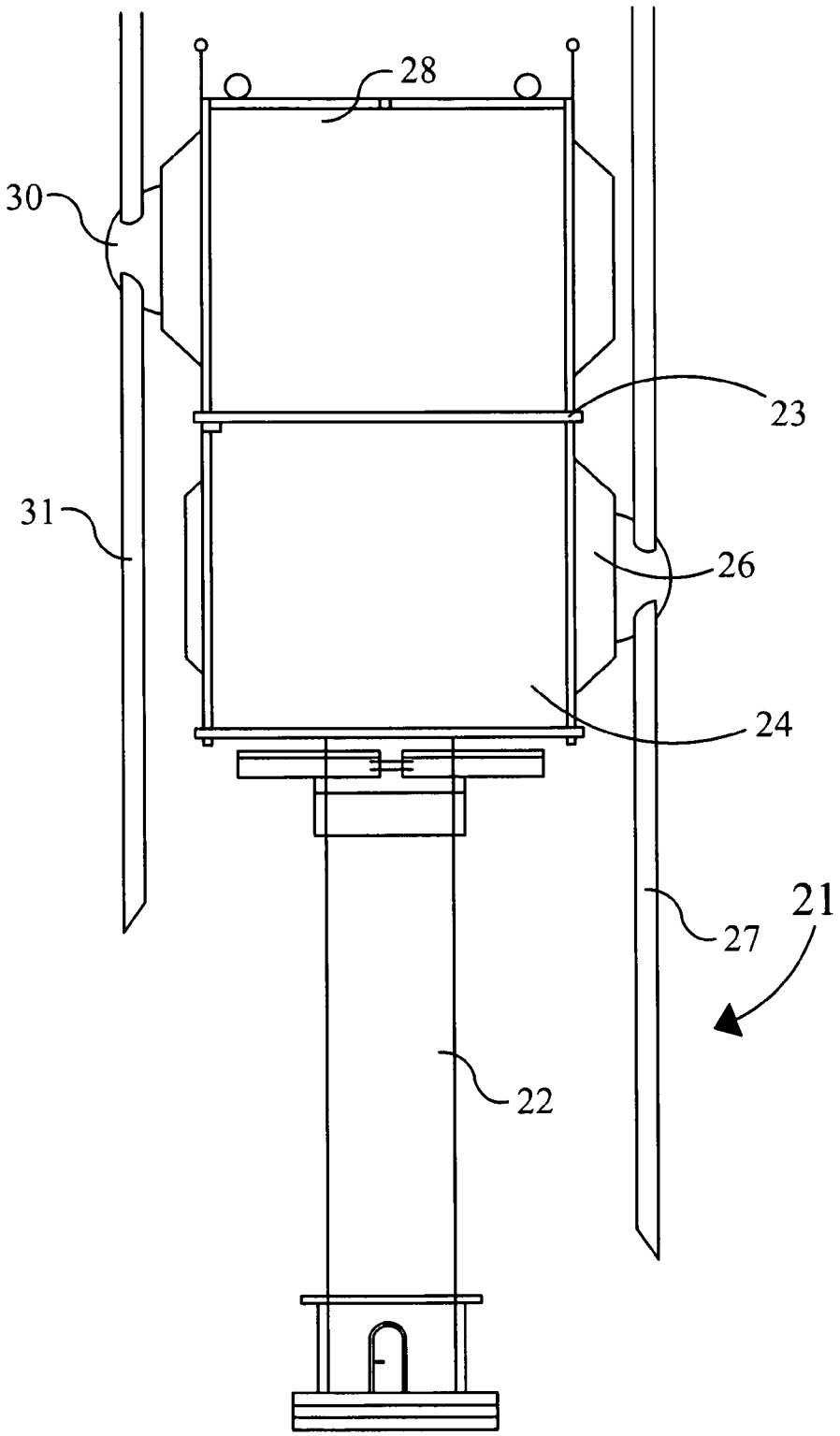


FIG. 2

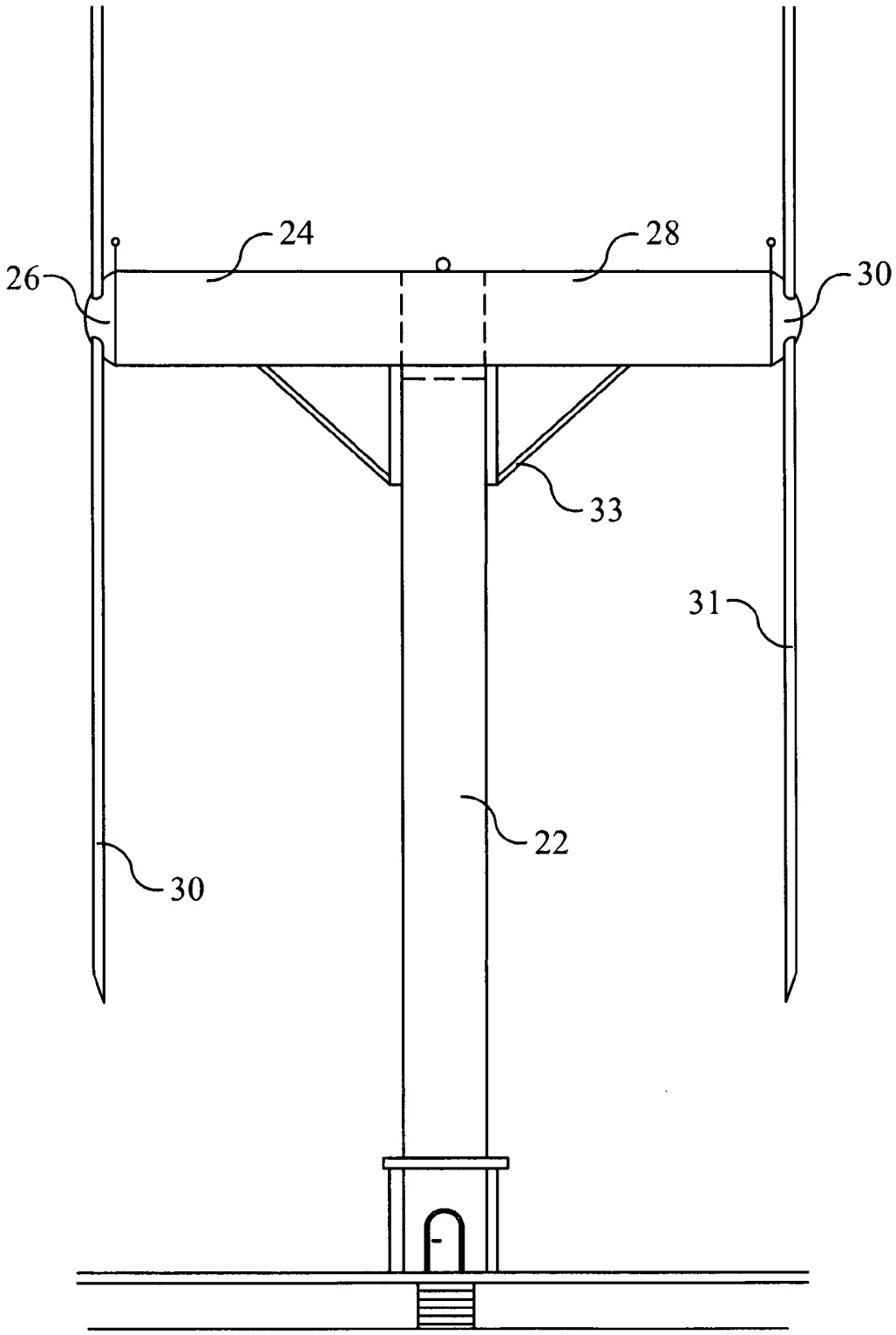


FIG. 3

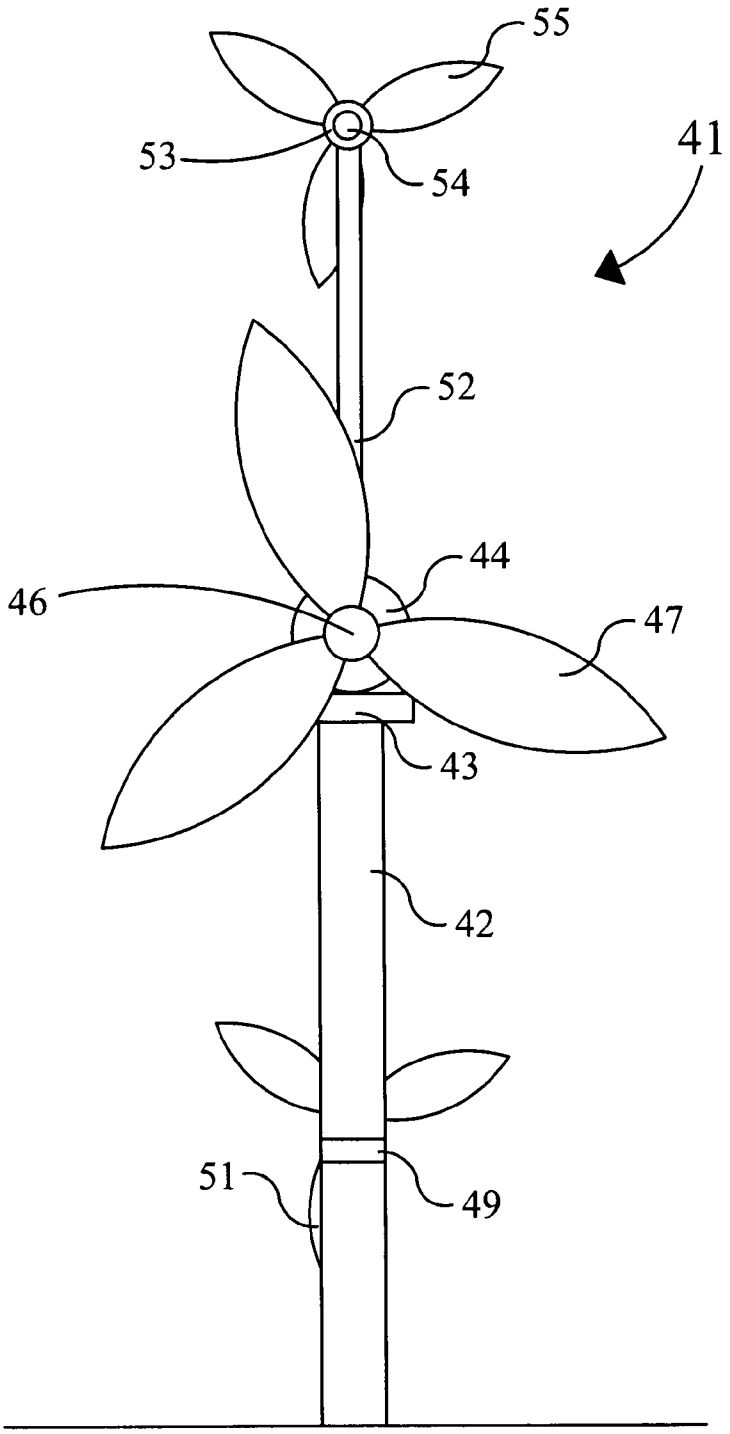


FIG. 4

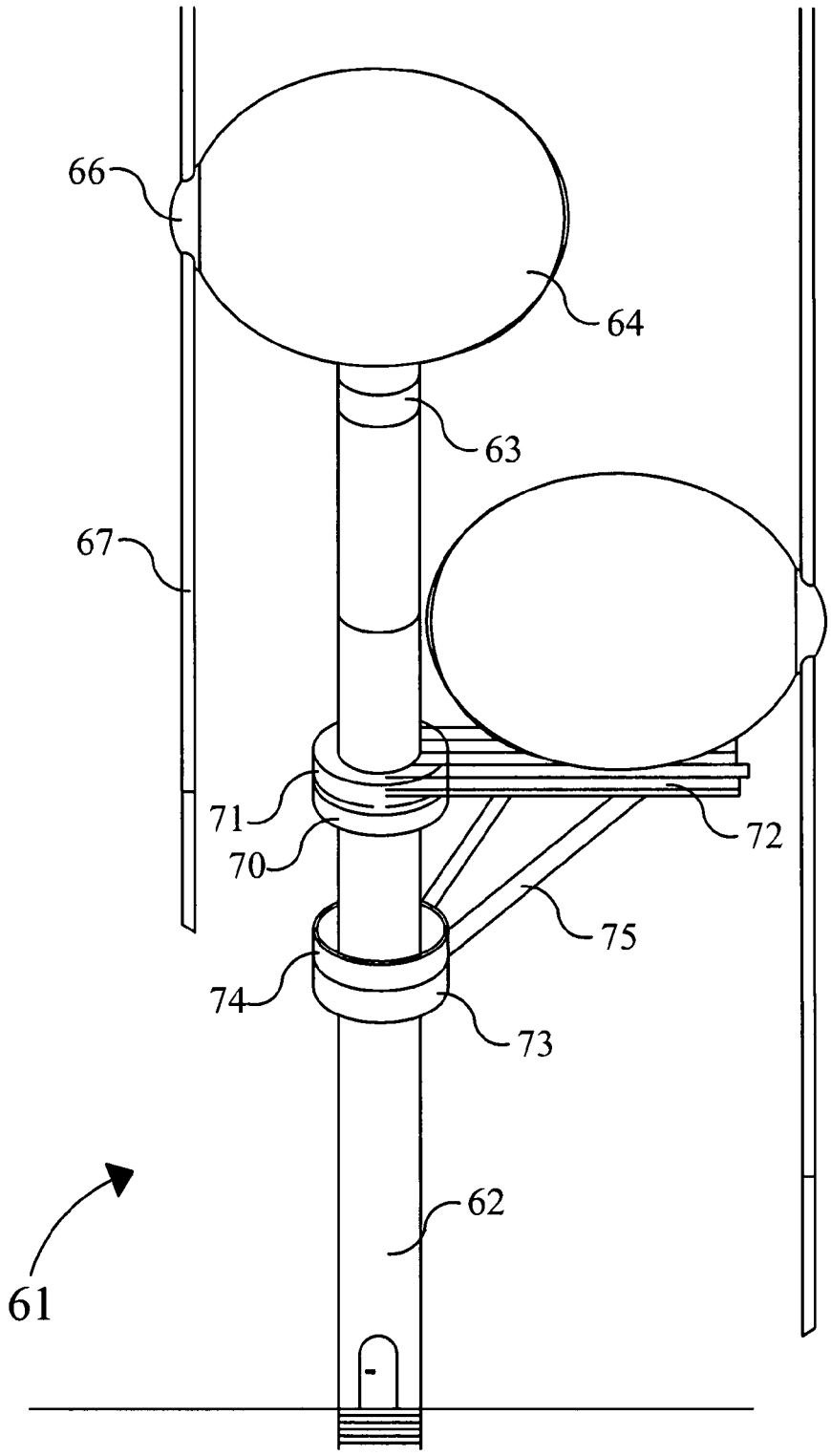


FIG. 5

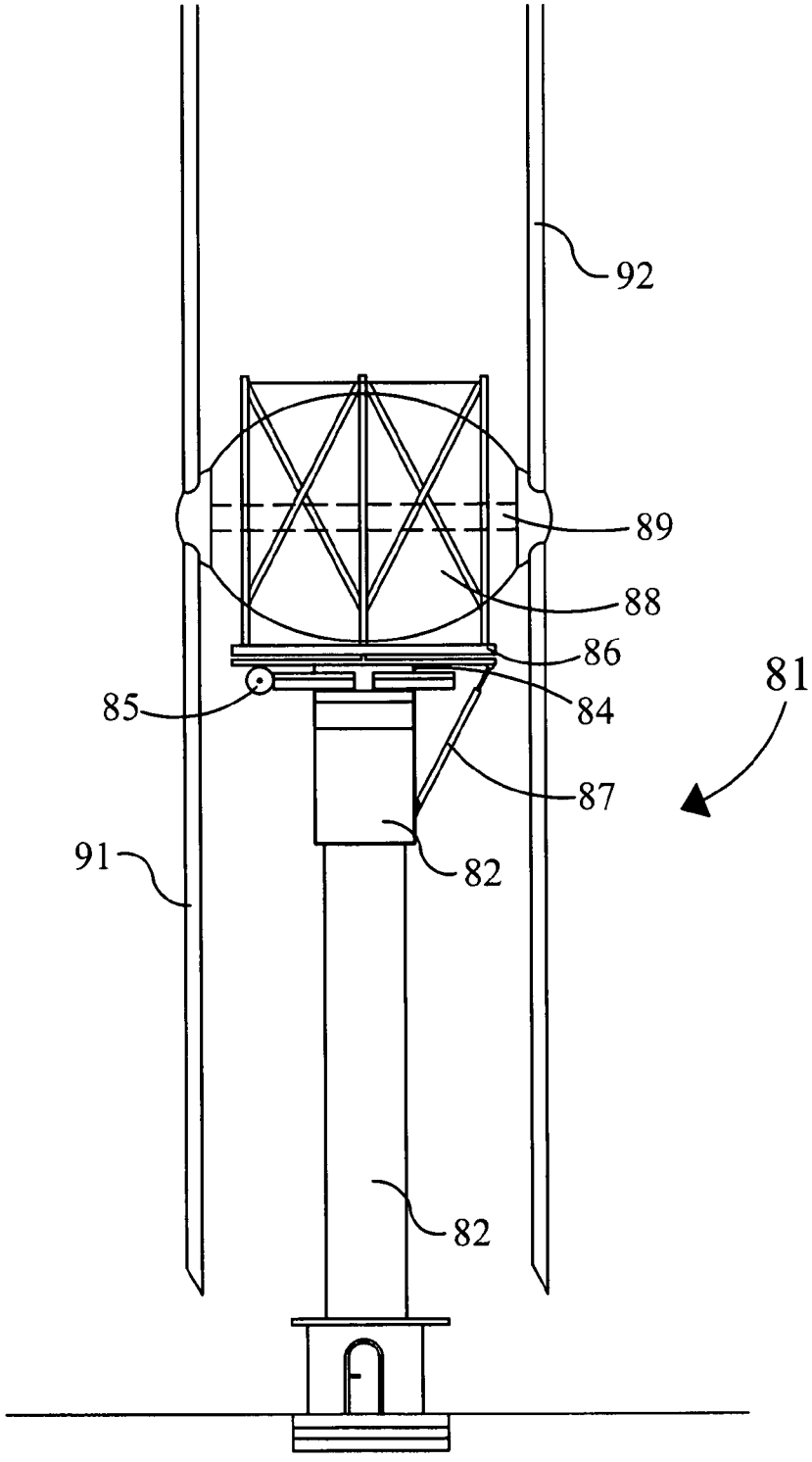


FIG. 6

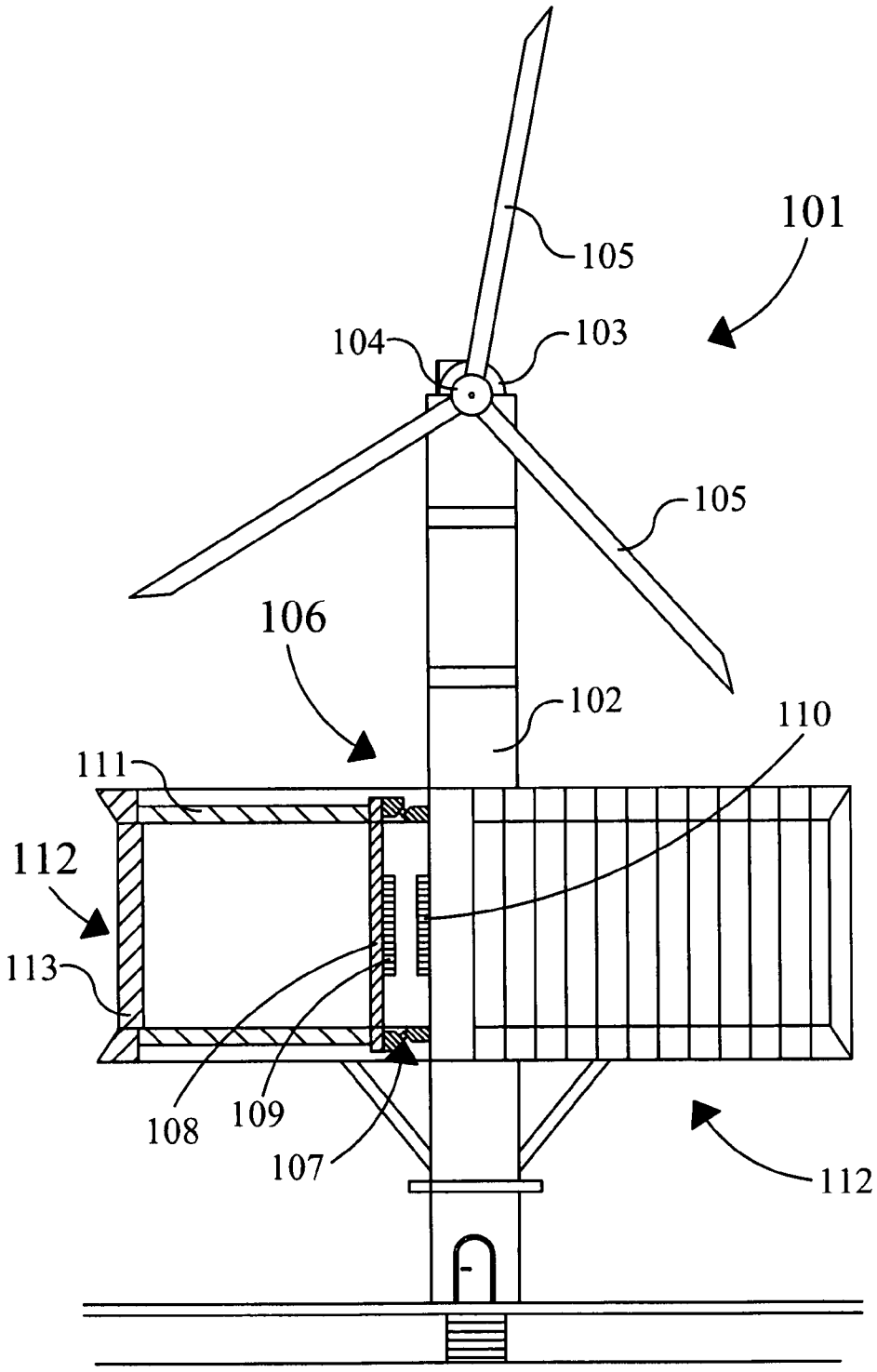


FIG. 7

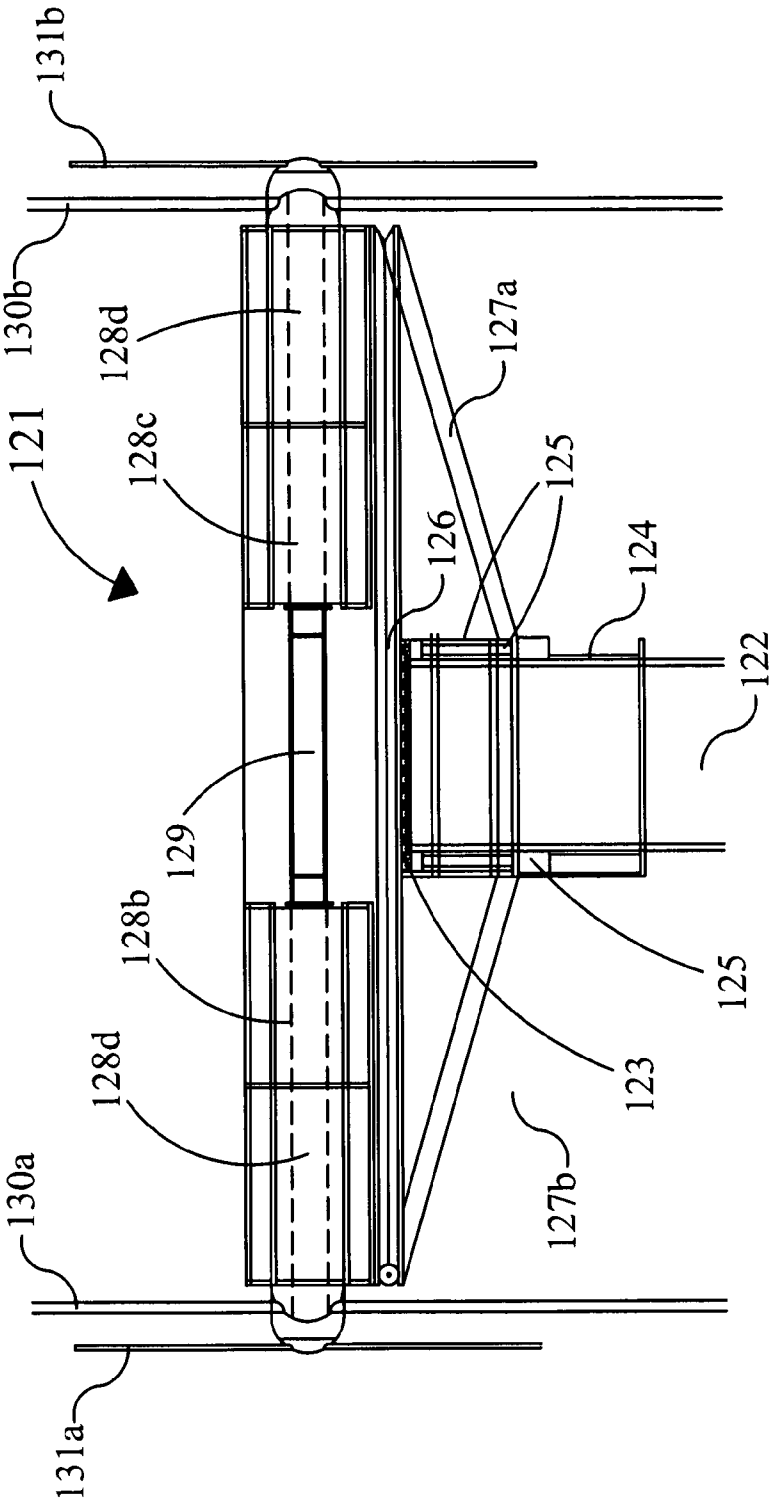

131b
130b
128d
121
128c
127a
125
126
124
122
129
128b
125
128d
123
130a
127b
131a

FIG. 8

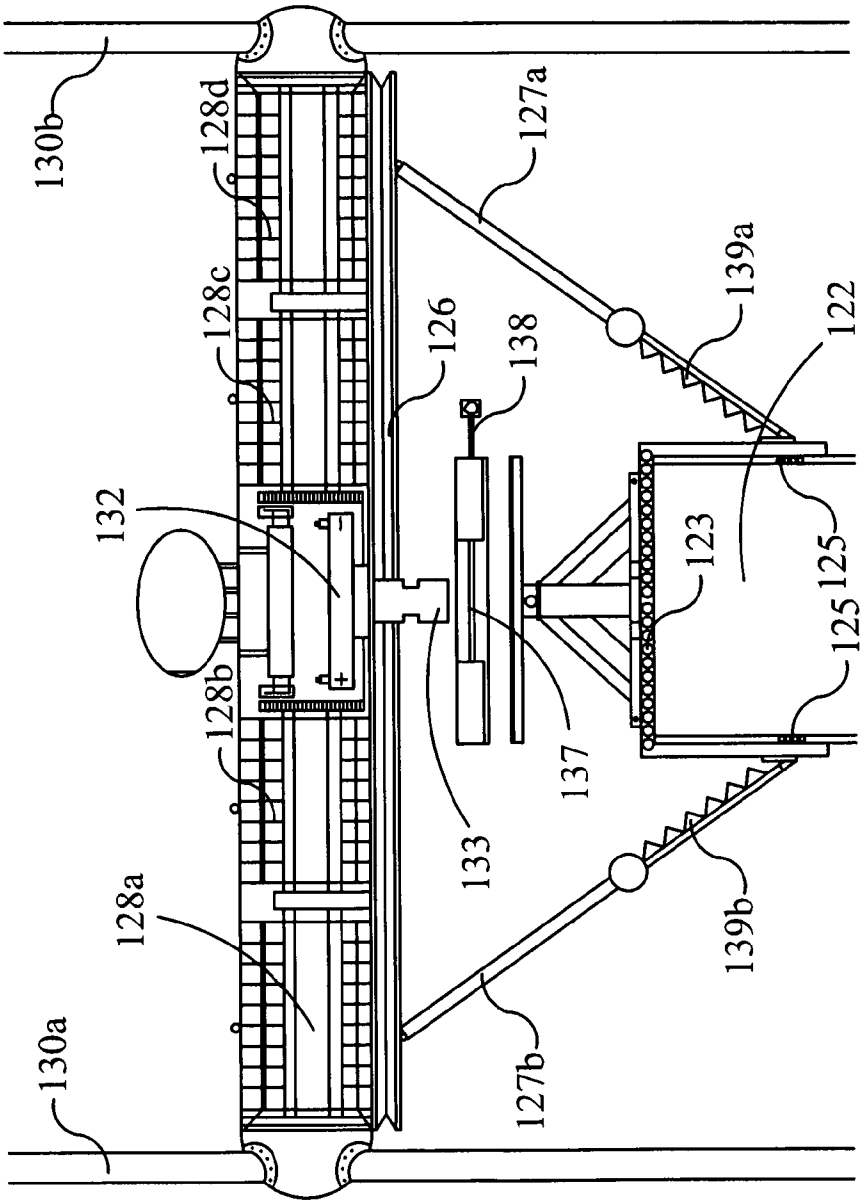

130b
128d
127a
128c
126
138
139a
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132
123
125
125
128b
137
133
139b
128a
130a
127b

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2012/050104

A. CLASSIFICATION OF SUBJECT MATTER
INV. F03D1/02 F03D3/02 F03D7/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010/098813 A1 (ENER2 LLC [US]; MOSER GEORGE [US]; LINN RANDY W [US]; WALWORTH VAN [US]) 2 September 2010 (2010-09-02)	1,2
A	paragraph [0106]	3-26
X	DE 26 20 862 A1 (SCHLAPP OTTO) 17 November 1977 (1977-11-17)	1-4,6-8, 19,20
Y	pages 5-10; figures 1,2	21
X	DE 44 44 757 A1 (LEHMANN KLAUS DIETER [DE]) 20 June 1996 (1996-06-20)	1-4,6-8, 19,20
A	columns 1-2; figure 1	21
X	US 2 177 801 A (ARNOLD ERREN RUDOLF) 31 October 1939 (1939-10-31)	1-4,6-8, 19,20
A	pages 1-2; figure 1	21

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 July 2012	11/07/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Beran, Jiri

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NL2012/050104

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2012/050104

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 039 848 A (WINDERL WILLIAM R) 2 August 1977 (1977-08-02)	1-4,6-8, 19,20
A	columns 1-6; figures 1,2	21
X	UA 79 256 C2 (KUDAREVKO MYRON VOLODYMYROVYCH [UA]; KUDAREVKO BOHDAN MYRONOVYCH [UA]) 11 June 2007 (2007-06-11)	1-4,6-8, 19,20
A	page 5, lines 42-44	21
X	DE 20 2009 009654 U1 (GLUNZ JOSEF [DE]) 24 September 2009 (2009-09-24)	1-4,6-8, 19,20
A	paragraphs [0015] - [0024]; figures 1-3	21
X	US 2008/211236 A1 (APPA KARI [US] ET AL) 4 September 2008 (2008-09-04)	1-3,6-8, 19,20
A	paragraphs [0021], [0033]; figures 1,9	4
Y	WO 2008/078342 A1 (HIGH TECHNOLOGY INVEST BV [NL]; PABST OTTO [IT]) 3 July 2008 (2008-07-03) page 4, line 7 - page 6, line 5; figures 1-17	21
X	DE 42 36 092 A1 (HISTEEL S A [CH]) 28 April 1994 (1994-04-28)	1,2,5, 9-12
Y	column 1, line 52 - column 2, line 68; figures 1-12	13-16
X	JP 2007 211667 A (KANKYO ENERGY KK) 23 August 2007 (2007-08-23)	1,2,5, 9-12
A	abstract	13-16
Y	WO 2010/098814 A1 (ENER2 LLC [US]; MOSER GEORGE [US]; LINN RANDY W [US]; WALWORTH VAN [US) 2 September 2010 (2010-09-02) paragraphs [0067], [0068], [0069]; figures 8,9	13-16
A	JP 2003 035249 A (FUJI HEAVY IND LTD) 7 February 2003 (2003-02-07) abstract; figures 1-5	13-15
A	WO 95/00757 A1 (RAJALAHTI KARI [FI]) 5 January 1995 (1995-01-05) page 4, line 22 - page 11, line 4; figures 1,2	13-15
X	EP 1 253 317 A2 (GROPPEL WILHELM [DE]) 30 October 2002 (2002-10-30) paragraphs [0005], [0007], [0017] - [0023]; figures 1-4	1,17,18, 23,24,26
X	EP 1 002 949 A2 (GROPPEL WILHELM [DE]) 24 May 2000 (2000-05-24) paragraphs [0009] - [0030]; figures 1-5	1,17,18, 22-24,26

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INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2012/050104

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 202 17 869 U1 (TWELSIEK ROBERT [DE]) 1 April 2004 (2004-04-01) paragraphs [0001] - [0022]; figure 1 -----	1,17,18, 22-25
X	CN 201 671 770 U (SU WU) 15 December 2010 (2010-12-15) abstract; figures 1,2 -----	1,17,18, 22-25

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2012/050104

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010098813 A1	02-09-2010	NONE	
DE 2620862 A1	17-11-1977	NONE	
DE 4444757 A1	20-06-1996	NONE	
US 2177801 A	31-10-1939	NONE	
US 4039848 A	02-08-1977	NONE	
UA 79256 C2	11-06-2007	NONE	
DE 202009009654 U1	24-09-2009	NONE	
US 2008211236 A1	04-09-2008	US 2008211236 A1	04-09-2008
		WO 2009105098 A1	27-08-2009
WO 2008078342 A1	03-07-2008	AR 064522 A1	08-04-2009
		AU 2006352297 A1	03-07-2008
		BR PI0622196 A2	03-01-2012
		CA 2673411 A1	03-07-2008
		CN 101627208 A	13-01-2010
		EP 2102496 A1	23-09-2009
		EP 2453130 A2	16-05-2012
		EP 2453131 A2	16-05-2012
		US 2010026010 A1	04-02-2010
		WO 2008078342 A1	03-07-2008
DE 4236092 A1	28-04-1994	NONE	
JP 2007211667 A	23-08-2007	NONE	
WO 2010098814 A1	02-09-2010	NONE	
JP 2003035249 A	07-02-2003	NONE	
WO 9500757 A1	05-01-1995	AU 7001594 A	17-01-1995
		FI 932916 A	24-12-1994
		WO 9500757 A1	05-01-1995
EP 1253317 A2	30-10-2002	DE 10120181 A1	07-11-2002
		EP 1253317 A2	30-10-2002
		US 2002153728 A1	24-10-2002
EP 1002949 A2	24-05-2000	DE 19853790 A1	31-05-2000
		EP 1002949 A2	24-05-2000
		JP 2000161197 A	13-06-2000
		US 6270308 B1	07-08-2001
DE 20217869 U1	01-04-2004	NONE	
CN 201671770 U	15-12-2010	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4, 6-8, 19-21

   a wind turbine with a two horizontal axis rotors connected to one common generator and whereby rotor perimeters overlap and rotors are operated synchronously

   ---

2. claims: 1, 2, 5, 9-16

   a wind turbine with two horizontal axis rotors each having an own generator and an own orientable nacelle whereby the rotors are operated independently from each other

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3. claims: 1, 17, 18, 22-26

   a horizontal axis wind turbine with a secondary vertical axis rotor retrofitted on the vertical tower under a first horizontal axis rotor

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